Geo Viz vs. Pro/Game PC 3D Estranged or Partners?

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Evans & Sutherland

Shifting Innovation Magnet

- **Innovations in 3D game ICs, APIs, content**
  - Talent & technology migration to 3D games
  - Poor economics to optimize for Sci/Geo/Eng Vis
- **Tricky allure of falling PC 3D cost in volume**
  - Fiction: $300 3D scaling up to Harmony, IR/Onyx
- **3D systems, ICs (vis sim, sci vis) challenged**
  - Open, flexible systems vs. fast wired 3D pipes
  - Game 3D IC brute force + prog. shaders knocking
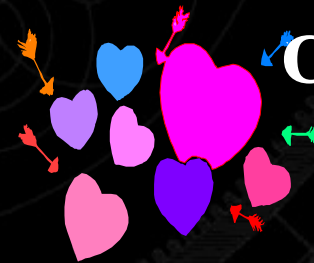
Bereft & Enchanted
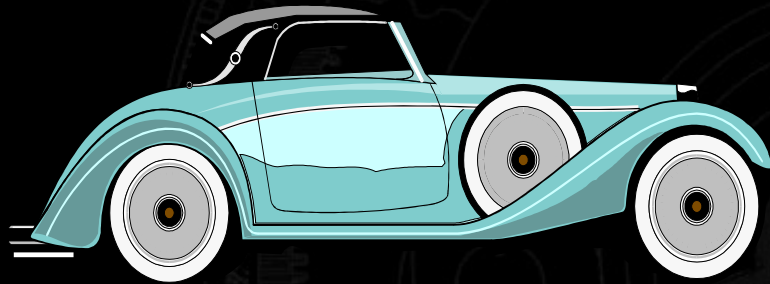
Sci/Geo/Eng 3D Visualization

RIP
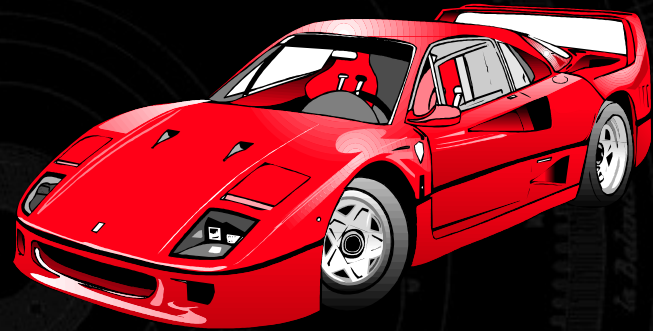
3D Game Content

3D Chip Sources

API

Sci/Geo/Eng Visualization Needs

- **Far-flung demands for modalities & fidelity**
  - Physics, molecular, geo, medical, materials, fluids
  - Accuracy in humongous multivariate data sets
- **Interactive visualization with data scalability**
  - Geometry, display scaling – big data, rich formats
- **Supercomputer scaling for hungry algorithms**
  - Multi-CPUs, networked HW rendering, computing
  - Stable APIs, control of OS / libraries (Unix, Linux)

3D Game Propulsion

- **Suspension of disbelief – reality & fantasy**
  - Movies, player appeal, story values, relationships
  - Human cueing, evocative content performance
- **Leapfrogging 3D power within a price cap**
  - Real-time, low-lag, photo-reality, special effects
  - Animation/morphing of scene structure, content
- **3D supercomputing ICs - annual feature trek**
  - API & content on steroids μsec's < Xmas release

Game 3D Content
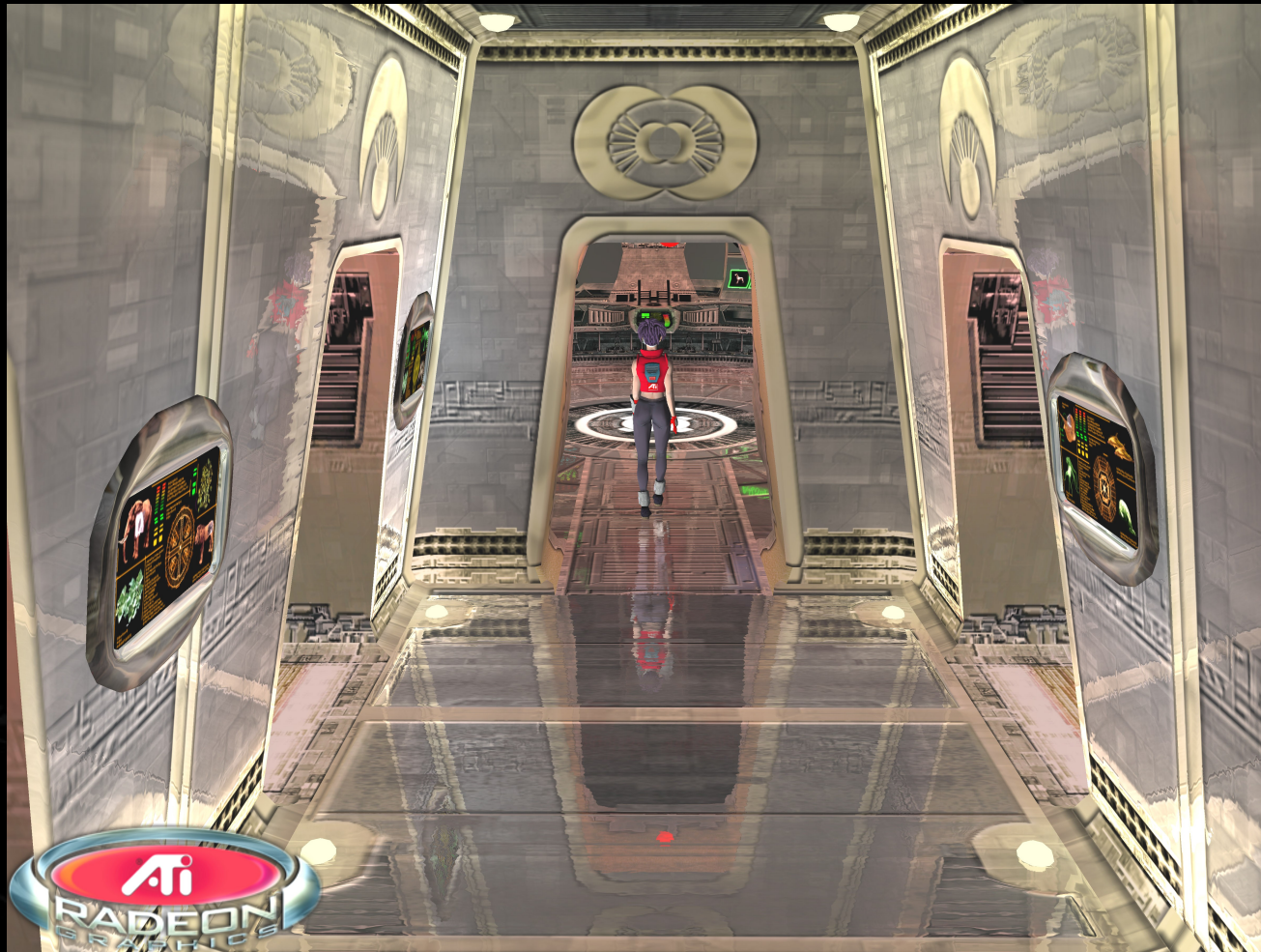

Images by ATI Radeon

Game 3D Content
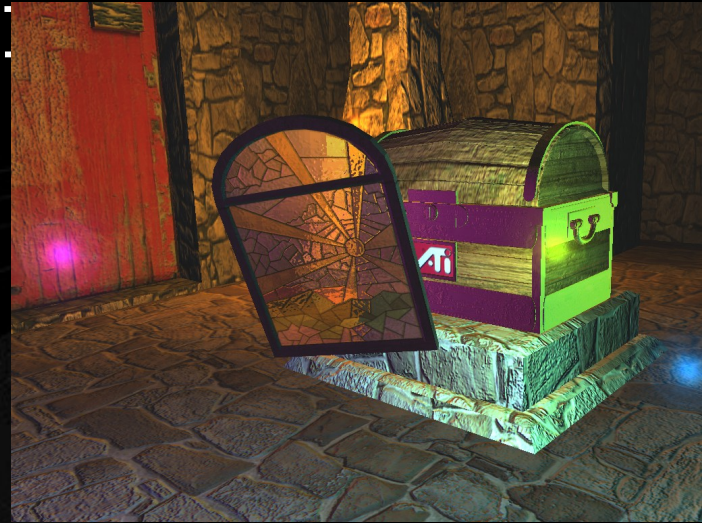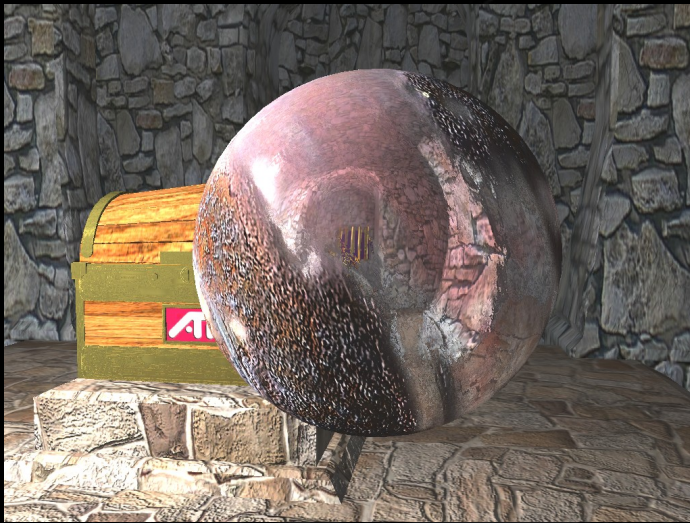

Images by ATI Radeon

SIGGRAPH 2001 EXPLORE INTERACTION AND DIGITAL IMAGES

Advanced Shaders

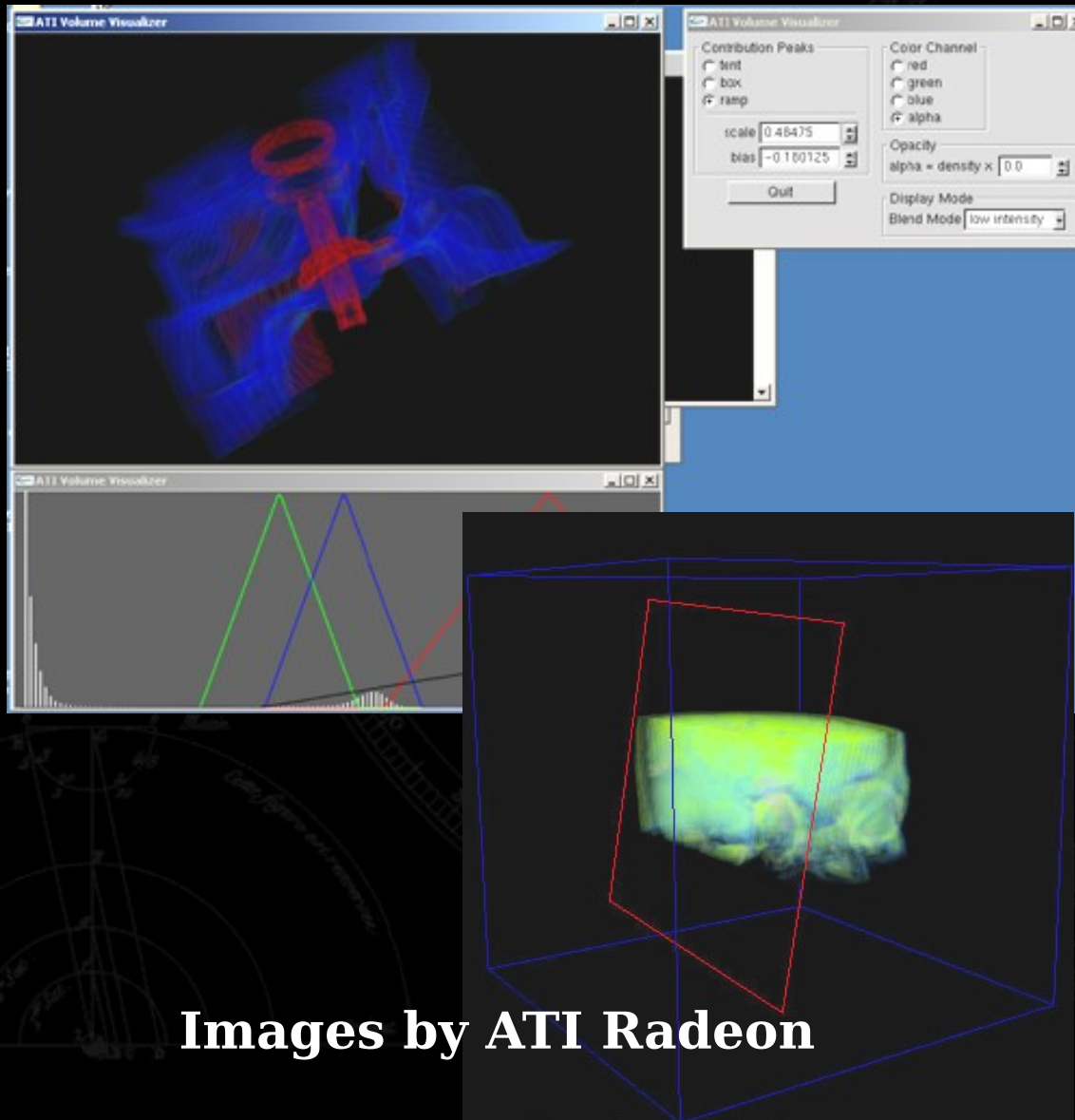**Images by ATI Radeon**

Advanced Shaders

Images by ATI Radeon

Advanced Shaders

Images by ATI Radeon

Game 3D in VolVis

Images by ATI Radeon

PC Urban Development Planning

Image by Evans & Sutherland

3D Chip & API Trends (D3D, OGL)

- **Programmable 3D pipelines – lurking giant**
  - Higher-order surfaces, prog. geometry shaders
  - Prog. pixel shaders for local lighting, texturing
- **Contemporary & coming game / pro 3D ICs**
  - Micro-polys (50-75 M Δ/s), high fill (1.2-1.5 GP/s)
  - Render to texture, unify FB+texture, fp precision
  - Multi-texture cascades, separable function lookups
  - 3D, BRDF, procedural texturing with A-A tradeoffs

Goal of Pro/Game Real-Time 3D

Image by Pixar

Technology Encroachment

Vis Sim

Visual Simulation

↑

Pro PC 3D Chips

↑

Game PC 3D Chips

↑

Video Consoles

3D-Video for All

E-Products
Home Design
Multimedia

Volume
Ease of use
Low Cost

Travel
Recreation
Real Estate

Pilot /
Operator
Training

Total real-time
Suspend disbelief
Task Loading
Presence

Games
DCC

All out
Price cap

Film
DVE

All out
Slow-time

Urban
Design

Being there
What ifs

MCAD / Eng Sim / Medical /
Molecular / GIS / Industrial
Design / Virtual Prototypes

Model Robustness
Malleability

Pro Vis

3D Lands of Occupation

SIGGRAPH
2001
*EXPLORE INTERACTION
AND DIGITAL IMAGES*

PC Geo Vis Sim Features

simFUSION

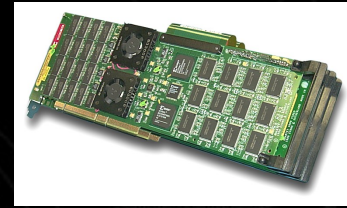| Latham's List	Gen 3D	PC Sim	Beyond Latham	Gen 3D	PC Sim
1. Parallel rendering for AA or fill	✓	✓	1. Basic sensor simulation	-	✓
2. Edge blending	✓	✓	2. Adv. sensor simulation	-	✓
3. Geometry engine	✓	✓	3. Calligraphic lights	-	✓
4. Genlock	-	✓	4. Global texture	✓	✓
5. Flexible video formats	✓	✓	5. Screen-door transparency	-	✓
6. Constant frame-rate mode	-	-	6. Fade LOD	-	✓
7. Load metric feedback	-	✓	7. Dynamic resolution	-	✓
8. Programmable gamma correction	✓	✓	8. Non-Linear Image Mapping	✓	✓
9. Color space translation	✓	✓	9. Multiple image suppression	-	✓
10. Paged texture memory	✓	✓	10. Overlay plane	✓	✓
11. Ownship illumination lights	-	✓	11. True-range fog	✓	✓
12. Coplanar (detail) faces	-	-	12. Anisotropic texture	✓	✓

✓available now

✓announced, or available but not completely satisfactory

PC Vis Simulation Feature Library

Software Architecture

Application

Scene Graph

Sim Feature Library

Graphics Library

Hardware

Hardware Architecture

Graphics   **ASIC**

PCI/AGP Interface

Geometry

Rasterizer

Shader

Texture Memory

Frame Buffer/Video interface

Frame Buffer
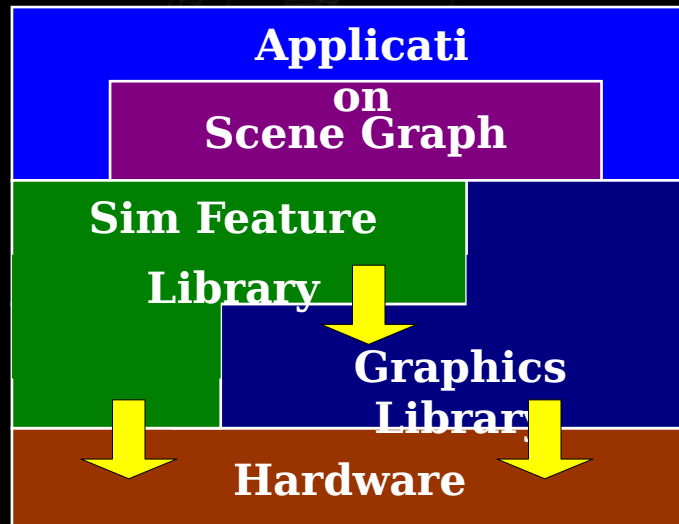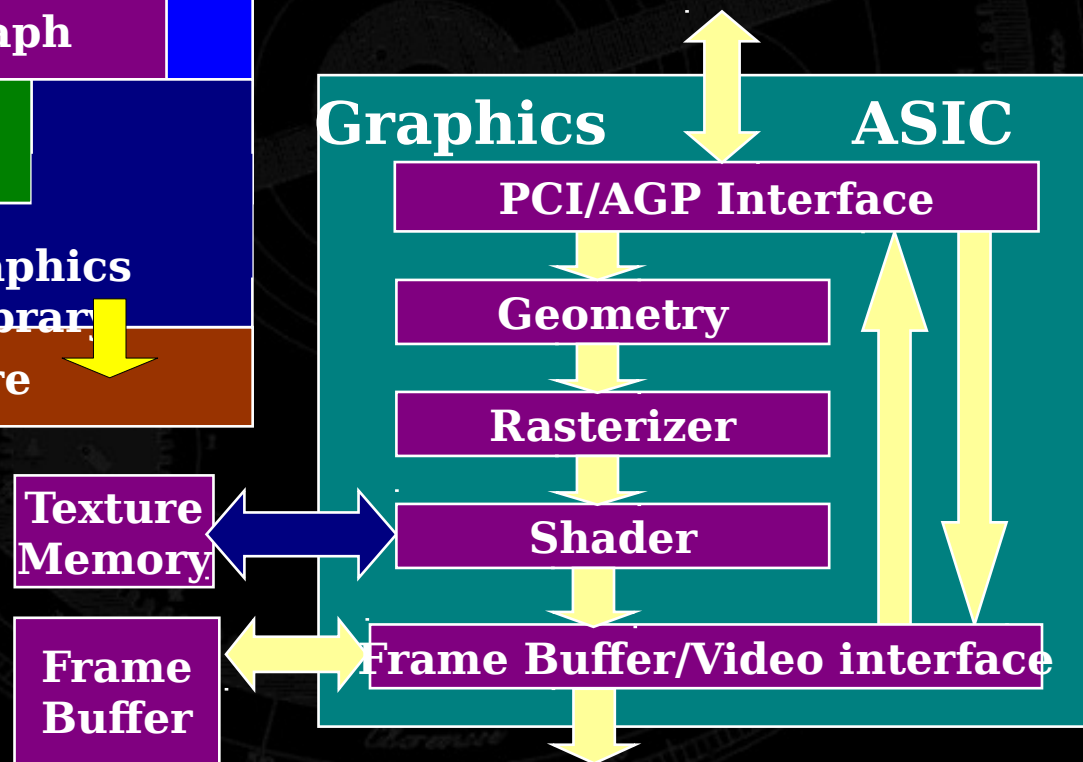
Scaling Up PC 3D for Sci/Geo Vis

- **Extending game/pro 3D ICs and APIs**
  - Deep data bit accuracy; higher geometry rates; more image area, depth complexity, A-A; tiling, binning, sorting for occlusion vs. direct FB access; pixel, frame multiplex — interleave mosaics; model / view segmenting for distributed rendering

- **Scaling up performance (realities & pitfalls)**

CPU Host Application → **GE** ↔ **RP** → **Mon**

Sci / Geo / Eng Vis Advocacy Now

- **Join & help 'em, withheld voice = no voice**
  - Falling cost → personal Sci/Geo/Eng 3D computing
- **Market dynamic – few niches remain unfilled**
  - Commodity ICs + architecture glue — special needs
- **API strategy, drivers, RIs are key issues**
  - Stability, quality, leadership, costly stumbles
- **Think: *leverage* evolving 3D architecture**
- **Video: *Harmony, simFUSION, RAPIDsite, RapidScene, ATI Radeon***